We claim:

1. An improvement in a method of epitaxially growing heterostructures on a virtual substrate comprised of an optoelectronic device substrate and handle substrate comprising:

initiating bonding of the device substrate to the handle substrate, where the device substrate is composed of a material suitable for fabrication of optoelectronic devices therein and where the handle substrate is composed of an inexpensive material suitable for providing mechanical support;

improving the mechanical strength of the device and handle substrates;

thinning the device substrate to leave a single-crystal film on the virtual substrate such as by exfoliation of a device film from the device substrate;

removing an upper portion of the device film exfoliated from the device substrate, to provide a smoother and less defect prone surface is provided for subsequent optoelectronic device fabrication, and

epitaxially growing the heterostructure on the smoothed surface.

2. The method of claim 1 where the device substrate is InP/Si and where epitaxially growing the heterostructure on the smoothed surface comprises epitaxially growing a photoluminescent InP/InGaAs/InP double heterostructure on the smoothed surface.

3. The method of claim 2 where removing an upper portion of the device film exfoliated from the device substrate comprises chemically polishing the upper portion with a damage selective etch, or mechanically polishing the upper portion.

4. The method of claim 1 where the device and handle substrates present a InP/Si interface and where chemically polishing the upper portion with a damage selective etch comprises etching with a mixture of $HCl:H_3PO_4:H_2O_2$ used in ratios of 1:2:2 or 1:2:4.

5. The method of claim 2 where the device and handle substrates present a InP/Si interface and where chemically polishing the upper portion with a damage selective etch comprises etching with a mixture of $HCl:H_3PO_4:H_2O_2$ used in ratios of 1:2:2 or 1:2:4.

6. The method of claim 1 where the device and handle substrates present an InP/Si interface and where mechanically polishing the upper portion comprises using a colloidal silica slurry in a sodium hypochlorite solution.

7. The method of claim 2 where the device and handle substrates present an InP/Si interface and where mechanically polishing the upper portion or both comprises using a colloidal silica slurry in a sodium hypochlorite solution.

8. The method of claim 1 further comprising disposing a strain compensation layer on the back surface of the handle substrate.

9. The method of claim 8 where the device and handle substrate interface is GaAs/Si, InP/Si or Ge/Si and where disposing a strain compensation layer on the back surface of the handle substrate comprises disposing a film of Ge on the back surface of the Si handle substrate.

10. The method of claim 1 where the device substrate is a silicon heterostructure with one material selected from the group consisting of III/V compound semiconductors, II/VI semiconductors, group IV semiconductors, and optical ferroelectric oxides, and where epitaxially growing the heterostructure on the smoothed surface comprises epitaxially growing a photoluminescent double heterostructure on the smoothed surface.

11. An improvement in a heterostructure device layer epitaxially grown on a virtual substrate comprising:

a device substrate;

a handle substrate, the virtual substrate being formed from the device and handle substrates in which the device substrate is bonded to the handle substrate, in which the device substrate is composed of a material suitable for fabrication of optoelectronic devices, in which the handle substrate is composed of a material suitable for providing mechanical support, in which the mechanical strength of the device and handle

substrates is improved, in which the device substrate is thinned to leave a single-crystal film on the virtual substrate such as by exfoliation of a device film from the device substrate, and in which an upper portion of the device film exfoliated from the device substrate is removed to provide a smoother and less defect prone surface for an optoelectronic device, and

a heterostructure epitaxially grown on the smoothed surface in which an optoelectronic device may be fabricated.

12. The improvement of claim 11 where the device substrate is comprised of InP/Si and where the heterostructure epitaxially grown on the smoothed surface comprises a photoluminescent InP/InGaAs/InP double heterostructure epitaxially grown on the smoothed surface.

13. The improvement of claim 12 where removing an upper portion of the device film exfoliated from the device substrate is chemically polished with a damage selective etch, or mechanically polished or both.

14. The improvement of claim 11 where the device and handle substrates present a InP/Si interface and where the upper portion is chemically polished with a damage selective etch comprised of etchants made of a mixture of $HCl:H_3PO_4:H_2O_2$ used in ratios of 1:2:2 or 1:2:4.

15. The improvement of claim 12 where the device and handle substrates present a InP/Si interface and where the upper portion is chemically polished with a damage selective etch etchants made of a mixture of $HCl:H_3PO_4:H_2O_2$.

16. The improvement of claim 15 where the mixture of $HCl:H_3PO_4:H_2O_2$ is used in ratios of 1:2:2 and 1:2:4

17. The improvement of claim 11 where the device and handle substrates present a InP/Si interface and where the upper portion is mechanically polished using a colloidal silica slurry in a sodium hypochlorite solution.

18. The improvement of claim 12 where the device and handle substrates present an InP/Si interface and where the upper portion is mechanically polished using a colloidal silica slurry in a sodium hypochlorite solution.

19. The improvement of claim 11 further comprising a strain compensation layer disposed on the back surface of the handle substrate.

20. `The improvement of claim 19 where the device and handle substrate interface is GaAs/Si, InP/Si or Ge/Si and where the strain compensation layer comprises a film of Ge disposed on the back surface of the Si handle substrate.

21. The improvement of claim 11 where the device substrate is a silicon heterostructure with one material selected from the group consisting of III/V compound semiconductors, II/VI semiconductors, group IV semiconductors, and optical ferroelectric oxides, and where the epitaxially grown heterostructure on the smoothed surface comprises a photoluminescent double heterostructure epitaxially grown on the smoothed surface.